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THE

Deſcription *and* Uſe

Of that neceſſary Inſtrument call'd,

GUNTER's Quadrant;

Whereby many propoſitions in *Aſtronomy*, &c. are very eaſily perform'd.

Such as the ſun's altitude at any time; his right aſcenſion and declination; his longitude or place in the ecliptic; his amplitude and azimuth; his riſing and ſetting; the hour of the day or night, and other concluſions exemplify'd at large.

To which is added,

A TABLE of the ſun's place and declination for every day in the year; alſo the time of the ſun's riſing and ſetting, calculated for the latitude of *LEEDS*, being 53 d. 50 m.

(Price Six Pence.)

LEEDS: Printed by J. Lister, 1745.

BRITISH MUSEUM
15 APR 66

The PREFACE.

THE following quadrant *has it's name from it's inventor Mr.* Edmund Gunter, *formerly profeſſor of aſtronomy at* Greſham-College; *which beſides the graduated limb, fixt ſights, and plumet, as common quadrants, it has likewiſe a* 4*th part of the ſtereographic-projection of the ſphere on the plane of the equinoctial, the eye being ſuppos'd to be in one of the poles; by which means great variety of uſeful queſtions in* aſtronomy, *&c. are eaſily ſolv'd. But as theſe quadrants are generally calculated and made for the latitude of* London, *they become more and more uſeleſs according as the difference of the latitude of places from* London *increaſes. I have therefore at the requeſt of ſeveral of my friends, mathematically inclin'd, calculated tables for making the ſaid quadrant for the latitude of* York *and* Leeds, *and alſo drawn up the following pages of it's deſcription and uſe, for the latitude of* 53 *d.* 50 *m. which I hope will be found uſeful according as it was intended.*

By

Geo. Gargrave.

Leeds,
Nov. 1744.

BRITISH MUSEUM
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The deſcription and uſe of Gunter's *Quadrant.*

1. THE *quadrant* is a fourth part of a circle, divided equally into 90 deg. and number'd by 10, 20, 30, &c. to 90 deg. each degree being ſubdivided in two, three, four, &c. parts, according to the largeneſs of the quadrant. But if it be a foot radius or upwards, the limb ought then to be divided diagonally by help of concentric circles, ſo that the altitude of the ſun, or ſtar, may be found at any time to a minute.

2. *To find the Sun's altitude at any time.* Lift up the centre of the quadrant ſo as the thread with the plummet may play freely by the ſide, and the ſun's beams paſs thro' the ſights; ſo ſhall the degrees cut by the thread in the limb, ſhew what is the altitude at the time of obſervation:

Example 1: On july 20th at noon the ſun's beams paſſing thro' the ſights, the thread will fall on 54 d. 30m. and ſuch is the ſun's meridian altitude for that day in latitude 53 d. 50 m.

Example 2. On auguſt 7th at 9 o'clock in the morning or 3 in the afternoon, the ſun's altitude will be found to be 36 d. 10 m.

Note. After the ſame manner may be found the altitude of the moon, ſtar, or any other object.

OF THE ECLIPTIC.

3. The *ecliptic* is repreſented by the arc figur'd with the characters of the 12 ſigns ♈, ♉, ♊, &c. each ſign being divided unequally into 30 deg. and are to be reckon'd from the character of the ſign.

4. *The ſun's place in the eliptic being given to find his right aſcenſion.* Lay the thread on the ſun's place in the ecliptic, and the degrees which it cuts in the limb will be the right aſcenſion required.

Example. Suppoſe the ſun be 14 d. 30m. in ♊; the thread being laid on the ecliptic to this degree, will cut 73 d. 10 m. in the limb, and that is the right aſcenſion required.

But if the ſun's place be more than 90 d. from the beginning of ♈, the right aſcenſion will be more than 90 d. and in this caſe the degrees cut by the thread muſt be taken from 180 d. to have the right aſcenſion; ſo if the ſun be 15 d. 30 m. in ♋, the thread will fall in the ſame place, and yet the right aſcenſion is 106 d. 50 m.

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5. *The right aſcenſion of the ſun being given to find his place in the ecliptic.* This is the converſe of the laſt, for lay the thread on the right aſcenſion in the limb, and it will cut the ſun's place in the ecliptic.

Example. Let the right aſcenſion be 53 d. 45 m. and his place in the ecliptic will be found to be 26 d. 00 m. in ♉; but if his right aſcenſion were 126 d. 15 m. then his place in the ecliptic would be 4 d. 00 m. in ♌, both which happen in the ſame point.

OF THE LINE OF DECLINATION.

6. *The line of declination* is drawn on the left ſide of the quadrant between the equator and two tropics, and divided from the beginning of ♈ downward into 23 d. 29 m.

7. *The ſun's place being given to find his declination.* Lay the thread and ſet the bead to the ſun's place in the ecliptic, then move the thread to the line of declination; and there the bead will fall on the degrees of declination ſought.

Example. If the ſun's place be 8 d. 30 m. in ♒, his declination at that time will be found to be 18 d. 10 m. ſouth.

8. *The ſun's declination being given to find his place in the ecliptic.* This is the converſe of the laſt, for the thread and bead being laid to the declination, and then mov'd to the ecliptic, will there ſhew the ſun's place.

Example. If the declination be 21 d. 00 m. the ſun's place will be found either 4 d. 00 m. in ♊

or 4 d. 0 m. in ♐, or 26 m. in ♋; or 26 d. 0 m. in ♑; and which of theſe four is the ſun's place, will be apparent from the time of the year.

OF THE CIRCLE OF MONTHS AND DAYS.

9. *This circle* is repreſented by the arc figur'd with january, february, march, &c. ſignifying the months, each month being divided unequally according to the number of days that are therein.

10. *The day of the month being given to find the ſun's meridian altitude.* Lay the thread to the day of the month, and the degrees cut in the limb will be the ſun's meridian altitude.

Example. Suppoſe the day given be the 15th of july; the thread being laid upon this day, will cut 55 d. 40 m. in the limb, the meridian altitude requir'd.

11. *The Sun's meridian altitude being given to find the day of the month.* The thread being laid to the ſun's meridian altitude in the limb doth alſo fall on the day of the month.

Example. Let the ſun's meridian altitude be 54 d. 30 m. the thread being ſet to this altitude in the limb will fall on july 20th or may 2d and which of the two it is, may eaſily be known from the time of the year.

OF THE HOUR LINES.

14. *The hour lines* are drawn between the

equator and trophies, and number'd at the equator by 6, 7, 8, 9, 10, 11, 12, at the tropic by 1, 2, 3, 4, 5, 6, 7, 8, that which is drawn from 12 in the equator to the middle of june repreſents the hour line of 12 in ſummer. And that which is drawn from 12 in the equator to the middle of december repreſents the hour line of 12 in winter.

13. *The ſun's meridian altitude being given, to find his place in the ecliptic.* The thread being laid to the day of the month, or the ſun's meridian altitude, for one gives the other (by § 10) mark where it croſſes the hour line of 12, and ſet the bead to that interſection; then move the thread till the bead fall on the ecliptic, and that point will be the ſun's place.

Example. Let the day given be the 25th may or the meridian altitude 58 d. 45 m. lay the thread accordingly, and rectify the bead, then move the thread till the bead fall on the ecliptic, and it will there ſhew the ſun's place to be 14 d. 30 m. in ♊.

14. *The ſun's place in the ecliptic being given, to find the day of the month or the ſun's meridian altitude.* Let the thread and bead be firſt laid on the ſun's place in the ecliptic, and then mov'd to the hour line of 12, and the thread will ſhew the day of the month, and the ſun's meridian altitude in the limb.

Example. Let the ſun be 20 d. 30 m. in ♉; the bead being laid to this degree and then mov'd to the hour line of 12 in ſummer the thread will fall on april 30th, and his meridian altitude will be found 54 d. 04 m. in the limb.

Note. In this and § 13. are given two ways to rectify the bead, viz. by the ſun's place or by the day of the month.

15. *The hour of the day being given to find the ſun's altitude.* The bead being rectified and the thread mov'd till the bead fall on the given hour; the degrees cut in the limb by the thread will give the ſun's altitude at that time.

Example. Let the time given be auguſt 7th, and it is requir'd to know the ſun's altitude at 9 o'clock the ſun being then 25 d. 13 m. in ♌, the bead being rectified you will find the ſun's meridian altitude to be 49 d. 18 m. and at 9 o'clock his altitude is 36 d. 10 m. after the ſame may manner his altitude may be found at 5, 6, 7, 8, 10, or 11 o'clock in the morning.

16. *The ſun's altitude being given to find the hour of the day.* The altitude being obſerv'd as before, let the bead be rectified, then bring the thread to the altitude, ſo the bead will ſhew the hour of the day.

Example. On july 13th let the ſun's altitude be 8 d. 04 m. and let the hour of the day be requir'd the bead being rectified for the day, and the thread laid to 8 d. 04 m. in the limb, the bead will ſhew the hour to be 5 in the morning or 7 in the evening.

Again, on december 10th, the ſun's altitude was obſerv'd 8 d. 27 m. the hour upon the quadrant will be found either 10 in the morning or 2 in the afternoon.

17. *The hour of the night being given to know how much the ſun is below the horizon.* The ſun

is always as much below the horizon at any hour at night as his oppoſite point is above the horizon at the hour of the day; therefore the bead being rectified, if it be any hour of the night in ſummer, then move it to the like hour of the day in winter, *& vice verſâ*; ſo the degrees cut by the thread in the limb is the ſun's depreſſion at that time.

Example. If it be required to know the ſun's depreſſion on april 1ſt at 4 o'clock in the morning or 8 at night; rectify the bead, and bring it to 4 o'clock in the winter hours, and the thread will cut the limb in 9 d. 20 m. and ſo much is the ſun below the horizon at that time.

18. *The time of the year or the ſun's place being given to find the beginniug of day-break and end of twilight.* This is much the ſame with the laſt, for the beginning and end of twilight is when the ſun is 18 d. below the horizon; wherefore let the bead be rectified for that time, and then bring the thread to 18 d. in the limb, ſo ſhall the bead fall on the contrary hour lines and then ſhew the hour of twilight.

Example. Let it be required to know at what time the day begins to break, as alſo the end of evening twilight on april 1ſt, the bead being rectified and the thread brought to 18 d. in the limb, the bead will fall in the winter hours, and there ſhew the day-break to be near 45 minutes paſt 2 in the morning, and the end of twilight about 15 minutes paſt 9 at night.

OF

OF THE HORIZON.

19. *The horizon* is here repreſented by the arc drawn from the beginning of declination towards the end of february divided unequally and number'd 10, 20, 30, 40.

20. *The day of the month, or the ſun's place being given to find the ſun's amplitude either riſing or ſetting.* Let the bead rectified for the time be brought to the horizon, and it will there ſhew the amplitude requir'd.

Example. Let it be requir'd to find the ſun's amplitude on july 11th, now if the bead be rectified and brought to the horizon it will there fall on 35 d. 30 m. and this is the ſun's amplitude of riſing from the eaſt or ſetting from the weſt.

21. *The day of the month, or the ſun's place being given to find the aſcenſional difference.* Let the bead rectified for the time be brought to the horizon, ſo the degrees cut by the thread in the limb ſhall ſhew the aſcenſional difference.

Example. Let the day given be may 9th, the bead being rectified and brought to the horizon, will ſhew the aſcenſional difference to be 30 d. 02 m. in the limb.

Upon the aſcenſional difference depends the following

Corollary.

To find the time of ſun's riſing and ſetting and thereby the length of the day and night.

For the aſcenſional difference being converted into time by allowing 15 deg. to 1 hour, and every 1 deg. to 4 minutes of time; it ſhews how much the ſun riſes before 6 in ſummer, and after 6 in winter.

Example 1. Let the day given be may 9th, the ſun's aſcenſional difference was found = 30 d. 02 m. as above, this converted into time is 2 hours, therefore the ſun at that time riſes at 4 in the morning, and ſets at 8 in the evening, and conſequently the day is 16 hours long.

Example 2. Let the ſun be in ♋ or ♑, his aſcenſional difference will be found to be 36 d. 28 m. = 2 h. 26 min. nearly; ſo that the ſun riſes 34 min. paſt 3 when in ♋, and ſets 26 min. paſt 8, therefore in our latitude the longeſt day is 16 hours 52 minutes, for double the time of the ſun's riſing gives the length of the night; and the time of ſun ſetting being doubled gives the length of the day; and as the time of ſun riſing and ſetting are the complements of each other to 12 hours; ſo the length of the day and night are the complements of each other to 24 hours. The time of the ſun's riſing in northern ſigns, is the time of his ſetting in ſouthern ſigns; and the time of the ſun's ſetting in ſouthern ſigns, is the time of his riſing in northern ſigns, & è contra. For inſtance, the ſun riſes at 3 hours 34 minutes when in ♋, which is the time of his ſetting when in ♑; alſo the ſun ſets at 8 hours 26 minutes when in ♋, and riſes 8 hours 26 minutes when in ♑.

OF THE AZIMUTH LINES.

22. *Thoſe lines* which are drawn between the

equator and the tropics, on that ſide of the quadrant next the ſights repreſent the azimuths, the uttermoſt towards the left hand repreſents the meridian. Thoſe lines which are drawn from the equator to the left hand ſhew the azimuth in ſummer, and thoſe other to the right hand, ſhew the ſame in winter.

23. *The day of the month and the ſun's azimuth being given to find the ſun's altitude.* Rectify the bead for the time, then move the thread till the bead fall on the azimuth, ſo the degrees cut by the thread in the limb ſhews the altitude required.

Example. Let the time given be auguſt 7th, rectify the bead for that time, ſo you'l find the ſun's meridian altitude, viz. in the ſouth=49 d. 10 m. when he is 10 d. from the ſouth his altitude is 48 d. 49 m. when 20 d. his altitude is 47 d. 46 m. when 30 d. his altitude is 45 d. 57 m. when 40 d. then 43 d. 19 m. when 50 d. then 39 d. 46 m. when 60 d. then 35 d. 14 m. when 70 d. then 29 d. 43 m. when 80 d. then 23 d. 16 m. when he is in the eaſt or weſt, viz. 90 d. from the meridian, then his altitude is 16 d. 22 m. when 100 d. then 8 d. 49 m. when 110 d. then is altitude is 0 d. 39 m. ſoon after which he ſets.

24. *The ſun's altitude being given to find on what azimuth, or point of the compaſs he bears from us.* Rectify the bead for the time and obſerve his altitude, as before, then bring the thread to the complement of that altitude, ſo the bead ſhall ſhew the altitude required.

Example. June 11th, the ſun's altitude was obſerv'd to be 29 d. 34 m. now 'tis requir'd to know his azimuth; rectify the bead for the time and remove the thread to 60 d. 26 m. the Complement of altitude or which is the ſame thing to 29 d. 34 m. from the right hand towards the left, and the bead will fall on 90 d. from the meridian, and therefore the point whereon the ſun beareth from us is either due eaſt or weſt, and which it is may eaſily be known from the time of the day.

25. *To find the four cardinal points upon an horizontal plain.* Firſt find the ſun's azimuth, and inſtantly lay the quadrant upon the plain, ſo that the face thereof may lay uppermoſt; then hold in your hand ſome ſmall ſtring with a plumet hanging thereto, and move the quadrant till the ſun caſts the ſhadow of the ſtring thro' the degree of the limb which was found for the azimuth, and thro' the centre of the quadrant; then holding the quadrant ſtill, draw right lines by each ſide thereof, and protract them ſo as that they may croſs each other, and theſe lines ſhall point out eaſt, weſt, noth and ſouth.

26. *To find how much a wall or plain declines from the zenith, or to find the reclination of a plain.* Apply the edge of the quadrant to the plain or wall, ſo that the centre may be downwards and the limb upwards; then hold a thread and plumet ſo that the thread may juſt touch the centre and the limb, and number the degrees between the plain and the thread, which ſhall ſhew the quantity in degrees of the plain's reclination.

27. *To find the elevation of the pole, and conſequently*

ſequently the latitude of any place. Firſt take the meridian altitude of the ſun by obſervation, and alſo the ſun's declination for the day from ſome ephemeris, which if it be northwards ſubtract, if ſouthwards add to the ſun's meridian altitude, and you have the complement of the pole's elevation, or height of the equinoctial, which ſubtracted from 90 deg. leaves the latitude of the place, which is ſo plain it needs no example.

OF THE FIVE STARS.

28. More *ſtars* might be laid down upon the quadrant, but theſe are ſufficient for finding the hour of the night at all times of the year, ſince there is one for every quarter of the ecliptic; beſides the ſtar at the end of pegaſſus's wing their right aſcenſion in time may be found in the following table.

A Table ſhewing the Magnitudes, Declination, and Right Aſcenſion in Time and Motion, of thirty of the moſt remarkable fixt Stars, rectified to the beginning of the Year 1744.

Names of the Stars.	Mag.	Declinat.		Rt. Aſcenſion in Time.			Rt. Aſcenſion in Motion.		
		d.	m.	h.	m.	ſ.	d.	m.	ſ.
Andromeda's Girdle	2	34	14 n.	0	55	0	0	13	45
Firſt * of Aries	4	18	1 n.	1	39	5	24	46	15
Bright * of Aries	2	22	14 n.	1	42	19	25	34	45
Bright * i'th' Whale Jaw	2	3	3 n.	2	48	21	42	5	15
Brighteſt of the 7 Stars	3	23	17 n.	3	31	38	52	54	30
Aldebaran, or Bull's Eye	1	15	58 n.	4	20	24	65	6	0
The Foot of Orion	1	8	31 s.	5	1	21	75	20	15
Middle * in Orion's Belt	2	1	24 s.	5	22	14	80	33	30
That in his Right Shoulder	1	7	20 n.	5	40	13	85	3	15
Syrius, or the Great Dog *	1	16	15 s.	6	32	44	98	11	0
Procyon, or Leſſer Dog	1	5	53 n.	7	24	34	111	8	30
South Head of Gemini	2	28	38 n.	7	28	16	112	4	0
Hydra's Heart	1	7	33 s.	9	12	22	138	5	30
The Lyon's Heart	1	13	13 n.	9	53	0	148	14	45
Deneb, or Lyon's Tail	2	16	0 n.	11	34	0	173	30	0
Algorab.	3	16	6 s.	12	0	38	180	9	30
Vindemiatrix	3	12	21 n.	12	47	17	191	49	15
Virgin's Spike	1	9	49 s.	13	9	28	197	22	0
Arcturus	1	20	46 s.	14	1	38	210	24	30
The South Ballance	2	14	57 s.	14	34	18	218	34	30
The North Ballance	2	8	25 s.	15	0	40	225	10	0
Bright * in the Serpent's Neck	2	7	15 n.	15	29	11	232	17	45
Scorpion's Heart	1	25	49 s.	16	10	58	242	44	30
The Serpent's Head	2	2	38 n.	17	20	4	260	1	0
Lyra, or the ſhining Harp	1	38	34 n.	18	25	6	276	16	30
Vulture's Heart	1	8	12 n.	19	34	53	293	43	15
Pegaſſus's Mouth	2	8	42 n.	21	27	55	321	58	45
Bright * in his upper Wing	2	13	49 n.	22	48	7	342	1	45
That in his lower Wing	2	13	44 n.	23	56	1	359	0	15
Andromeda's Head	2	27	40 n.	23	51	7	357	46	45

29. *The altitude of any ſtar upon the quadrant being given to find the hour of the night.* Firſt put the bead to the ſtar which you intend to obſerve, then take it's altitude, and find how many hours it is from the meridian (by §. 16.) Then out of the right aſcenſion of the ſtar, take the right aſcenſion of the ſun converted into time and mark the difference, for this difference added to the obſerv'd hour of the ſtar from the meridian, will ſhew how many hours the ſun is gone from the meridian, which is in effect the hour of the night.

Example 1. As if on may 25th the ſun be then 14 d. 30 m. in ♊. I ſet the bead to arcturus, and obſerving his altitude to be in the weſt = 49 d. 30 m. and the bead to fall on the hour line of 2 afternoon, the hour wou'd be found to be 9 min. paſt 11 at night.

For 73 d. 10 m. the ſun's right aſcenſion (found by §. 4.) converted into time is = 4 h. 52 m. 40 ſ. which if you take from 14 h. 1 m. 38 ſ. the right aſcenſion of arcturus, the difference will be = 9 h. 9 min. nearly; and this being added to 2 hours, the obſerv'd diſtance of arcturus from the meridian ſhews the hour of the night to be 11 h. 9 min. as was requir'd.

Example 2. If on july 16th the ſun be then in ♌ 4 d. 00 m. I ſhould ſet the bead to aldebaran, and obſerving it's altitude ſhould find it in the eaſt to be 13 d. high and the bead to fall on the hour line of 6 before noon, which is 18 hours paſt the meridian, the hour will be found to be 55 min. paſt 1 in the morning.

For 126 d. 15 m. the right aſcenſion of the ſun (= 8 h. 25 m. taken from 4 h. 20 m. the right aſcenſion of aldebaran (adding 24 hours as ſubtraction cannot be had) the difference will be 19 h. 55 min. and this being added to 18 h. which was the obſerv'd diſtance of aldebaran from the meridian, ſhews that the ſun (abating 24 hours) is 13 h. 55 min. paſt the meridian, and therefore 55 m. paſt 1 in the morning.

30. *To find the time of a ſtar's coming upon the meridian; or to find the ſouthing of any of the fixt ſtars.* Subtract the right aſcenſion of the ſun, (found by §. 4.) from the right aſcenſion of the ſtar, adding 24 hours to the right aſcenſion of the ſtar if ſubtraction cannot be had, the remainder is the time of the ſtars coming to the meridian.

Example. If it were required to know what time will Syrius come to the meridian on december 25th.

	h.	m.
Right aſcenſion of ſyrius is	6	33
Ditto of the ſun —— ——	19	4
Remainder (24 hours being added to the right aſcenſion of ſyrius.)	11	29

So that ſyrius ſouths 29 min. paſt 11 at night.

31. *By the altitude of a ſtar when upon the meridian to find the latitude of a place.* Note, In north latitude thoſe ſtars whoſe north declination

exceeds the complement of latitude may be obſerv'd under the pole.

This may be reduc'd to 4 rules, as follows.

Rule 1. When the ſtar is between the horizon and equinoctial, ſubtract the declination from the complement of altitude (call'd alſo the zenith diſtance) the remainder is the latitude of the place.

	d.	m.
Example. Suppoſe the complement of altitude be —— ——	70	30
The declination ſouth —— ——	40	00
The latitude is —— ——	30	30

Rule 2. When the ſun or ſtar is between the equinoctial and zenith; add the complement of altitude to the declination the ſun is the latitude of the place.

	d.	m.
Example. If the complement of altitude be —— —— ——	35	00
The declination north ——	10	00
The latitude will be ——	45	00

Rule 3. When the ſun or ſtar is between the zenith and elevated pole, ſubtract the zenith diſtance, or complement of altitude from the declination, the remainder is the latitude.

Example.

	d.	m.
Example. If the declination be —	20	00
Complement of altitude —	10	45
The latitude is — —	9	15

Rule 4. When the ſun or ſtar is between the elevated pole and the horizon, or which is the ſame, when the ſun or ſtar is ſeen under the pole; then add the altitude of the ſun or ſtar to the complement of its declination, the ſum is the latitude of the place.

	d.	m.
Example. Let the ſtar's altitude above the horizon be —	5	00
Declination 22 d. 00 m. (its complement is) — —	68	00
The ſum is the latitude — —	73	00

OF THE QUADRAT.

32. *The quadrat* hath two ſides divided, the other two ſides next the centre may be ſuppoſed to be divided each of them into 100 equal parts; of the ſides divided, that which is next the horizontal line contains the parts of right ſhadow, and the other next the ſights the parts of contrary ſhadow.

33. *Any point being given to find whether it be level with the eye.* Lift up the centre of the

quadrant, ſo as the thread with the plummet may play eaſily by the ſide of it; then look thro' the ſights to the place given; for now if the thread ſhall fall on the horizontal line, A. B. then is the place given level with the eye, but if it ſhou'd fall within the ſaid line on any of the diviſions, then it is higher; if without, then it is lower than the level of the eye.

34. *To find an height above the level of the eye, or a diſtance at one obſervation.* Look thro' the ſights to the place going nearer or farther from it, till the thread fall on on 100 parts in the quadrat, or 45 deg. in the quadrant; ſo ſhall the height of the place above the level of the eye be equal to the diſtance between the place and the eye.

If the thread fall on 50 parts of right ſhadow, the height is but half the diſtance; if it fall on 25 it is a quarter of the diſtance; if on 75 it is three quarters of the diſtance; for as oft as the thread falls on the parts of right ſhadow.

As 100, to the parts on which the thread falls::
So is the diſtance, to the height required.

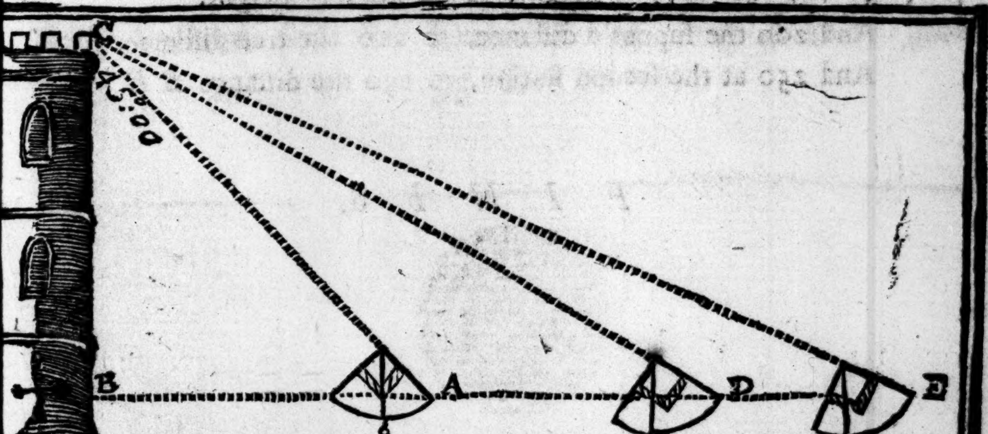
On the contrary.

As the parts cut by the thread, are to 100::
So is the height unto the diſtance.

But when the thread ſhall fall on the parts of contrary ſhadow: For example, if it falls on 50 parts, the height is then double to the diſtance, if on 25, it is four times as the diſtance. For as oft as the thread falls on the parts of contrary ſhadow.

As the parts cut by the thread, are to 100 ∷
So is the diſtance to the height.

35. *To find the height, or a diſtance at two obſervations.* As if the place which is to be meaſur'd might not otherwiſe be approach'd, and yet it were requir'd to find the height *B C* and the diſtance. Firſt make choice of a ſtation at *A* where the thread may fall on 100 parts in the quadrat, or 45 deg. n the quadrant, the diſtance *A B* will then be equal to the height *B C*; and if you go farther in a direct line with the former diſtance, and make choice of a ſecond ſtation at *D*, where the thread may fall on 50 parts of right ſhadow; the diſtance *B D* will then be double to the height *B C*; now meaſure the difference between the two ſtations *A* and *B*, and this difference, viz. *A D* will equal both to the height *B C* as alſo its diſtance *A B*.



Or if you cannot make choice of ſuch ſtations, take ſuch as may; one at *D* where the thread falls on 50 parts of right ſhadow, the ſecond at *E* where it falls on 40 parts, and ſuppoſing the height *B C* = 100, you'l find that

As 50 parts, are to 100, the ſide of the quadrat : :
So 100, the ſuppoſed height, to 200 the diſtance *B D*.
And as 40 parts, at the ſecond ſtation, to 100 : :
So is 100 the ſuppoſed height, to 250 the diſtance *B E*.

Wherefore the difference between the ſtations *D* and *E* ſeems to be 50; and then if in meaſuring it, you ſhould find it either more or leſs, the proportion will hold: As from the ſuppoſed difference, to the meaſur'd difference, ſo from height to height, and from diſtance to diſtance.

As if the difference between the two ſtations *D* and *E* being meaſur'd be found = 30 parts.

As 50 the ſuppos'd difference, to 30 the true difference : :
So 100 the ſuppos'd height, to 60 the true height.
And 200 the ſuppos'd diſtance, to 120 the true diſtance,
And 250 at the ſecond ſtation, to 150 the diſtance *B E*.

FINIS.

BRITISH MUSEUM 15 66 APR

A
TABLE
Of the
Sun's Place, and Declination,
For every Day in the Year.

As alſo
The Sun's Riſing and Setting.

Calculated for the Latitude of *LEEDS*, being
53 d. 50 m.

January 31 days.								Mo. day	*February* 28 days.							
Sun's place.		Sun's declin.		Sun riſes.		Sun ſets.			Sun's place.		Sun's declin.		Sun riſes.		Sun ſets.	
d.	m.	d.	m.	h.	m.	h.	m.		d.	m.	d.	m.	h.	m.	h.	m.
22♑	14	21	S 38	8	11	3	49	1	23♒	42	13	S 39	7	17	4	43
23	15	21	29	8	10	3	50	2	24	42	13	19	7	15	4	45
24	16	21	18	8	9	3	51	3	25	43	12	58	7	13	4	47
25	17	21	8	8	7	3	53	4	26	44	12	38	7	11	4	49
26	18	20	56	8	5	3	55	5	27	44	12	17	7	9	4	51
27	20	20	44	8	4	3	56	6	28	44	11	56	7	7	4	53
28	21	20	32	8	3	3	57	7	29	45	11	35	7	5	4	55
29	22	20	19	8	1	3	59	8	♓	45	11	14	7	3	4	57
♒	23	20	7	8	0	4	0	9	1	46	10	53	7	1	4	59
1	24	19	53	7	59	4	1	10	2	46	10	31	6	59	5	1
2	25	19	40	7	57	4	3	11	3	46	10	9	6	57	5	3
3	26	19	25	7	56	4	4	12	4	47	9	46	6	55	5	5
4	27	19	11	7	54	4	6	13	5	47	9	24	6	53	5	7
5	28	18	56	7	52	4	8	14	6	47	9	2	6	51	5	9
6	29	18	41	7	50	4	10	15	7	47	8	40	6	49	5	11
7	30	18	26	7	49	4	11	16	8	48	8	17	6	46	5	14
8	30	18	10	7	47	4	13	17	9	48	7	54	6	44	5	16
9	31	17	54	7	45	4	15	18	10	48	7	32	6	42	5	18
10	32	17	38	7	43	4	17	19	11	48	7	9	6	39	5	21
11	33	17	21	7	41	4	19	20	12	48	6	46	6	37	5	23
12	34	17	4	7	40	4	20	21	13	48	6	23	6	35	5	25
13	35	16	47	7	38	4	22	22	14	48	6	0	6	33	5	27
14	36	16	29	7	36	4	24	23	15	48	5	37	6	30	5	30
15	36	16	11	7	34	4	26	24	16	48	5	13	6	28	5	32
16	37	15	53	7	31	4	29	25	17	48	4	50	6	26	5	34
17	38	15	35	7	29	4	31	26	18	48	4	26	6	24	5	36
18	39	15	16	7	27	4	33	27	19	47	4	3	6	22	5	38
19	39	14	57	7	25	4	35	28	20	47	3	39	6	20	5	40
20	40	14	38	7	23	4	37	29								
21	41	14	18	7	21	4	39	30								
22	41	13	59	7	19	4	41	31								

March						31 days.		Mo. day	*April*						30 days.	
Sun's place.		Sun's declin.		Sun riſes.		Sun riſes.			Sun's place.		Sun's declin.		Sun riſes.		Sun ſets.	
d.	m.	d.	m.	h.	m.	h.	m.		d.	m.	d.	m.	h.	m.	h.	m.
21 ♓	47	3 S	16	6	18	5	42	1	22 ♈	23	8 N	43	5	12	6	48
22	47	2	52	6	15	5	45	2	23	21	9	5	5	10	6	50
23	46	2	29	6	13	5	47	3	24	20	9	27	5	8	6	52
24	46	2	5	6	10	5	50	4	25	18	9	49	5	6	6	54
25	46	1	41	6	8	5	52	5	26	17	10	10	5	4	6	56
26	45	1	17	6	6	5	54	6	27	15	10	31	5	2	6	58
27	45	0	54	6	4	5	56	7	28	14	10	52	4	0	7	0
28	44	0	30	6	2	5	58	8	29	12	11	13	4	58	7	2
29	44	0	6	6	0	6	0	9	♉	11	11	34	4	55	7	5
♈	43	Nor.	18	5	58	6	2	10	1	9	11	54	4	53	7	7
1	43	0	41	5	56	6	4	11	2	8	12	14	4	51	7	9
2	42	1	5	5	54	6	6	12	3	6	12	34	4	49	7	11
3	41	1	28	5	52	6	8	13	4	4	12	54	4	47	7	13
4	41	1	52	5	50	6	10	14	5	3	13	14	4	45	7	15
5	40	2	15	5	48	6	12	15	6	1	13	33	4	43	7	17
6	39	2	39	5	46	6	14	16	6	59	13	52	4	41	7	19
7	38	3	3	5	44	6	16	17	7	57	14	11	4	39	7	21
8	38	3	26	5	41	6	19	18	8	55	14	30	4	37	7	23
9	37	3	49	5	39	6	21	19	9	54	14	49	4	35	7	25
10	36	4	13	5	37	6	23	20	10	52	15	7	4	33	7	27
11	35	4	36	5	35	6	25	21	11	50	15	25	4	32	7	28
12	34	5	0	5	33	6	27	22	12	48	15	42	4	30	7	30
13	33	5	23	5	31	6	29	23	13	46	16	0	4	28	7	32
14	32	5	45	5	29	6	31	24	14	44	16	17	4	26	7	34
15	31	6	7	5	27	6	33	25	15	42	16	35	4	24	7	36
16	30	6	30	5	24	6	36	26	16	40	16	51	4	22	7	38
17	29	6	52	5	22	6	38	27	17	38	17	7	4	20	7	40
18	27	7	15	5	20	6	40	28	18	36	17	24	4	18	7	42
19	26	7	41	5	18	6	42	29	19	33	17	39	4	17	7	43
20	25	8	3	5	15	6	45	30	20	31	17	55	4	15	7	45
21	24	8	22	5	13	6	47	31								

	May		31 days.						Mo. day	*June*		30 days.					
	Sun's place.		Sun's declin.		Sun rises.		Sun sets.			Sun's place.		Sun's declin.		Sun rises.		Sun sets.	
	d.	m.	d.	m.	h.	m.	h.	m.		d.	m.	d.	m.	h.	m.	h.	m.
	21 ♉	29	18 N	10	4	13	7	47	1	21 ♊	12	23 N	11	3	37	8	23
	22	27	18	25	4	12	7	48	2	22	9	23	15	3	36	8	24
	23	25	18	39	4	10	7	50	3	23	6	23	18	3	36	8	24
	24	22	18	52	4	8	7	52	4	24	3	23	21	3	35	8	25
	25	20	19	8	4	7	7	53	5	25	1	23	23	3	35	8	25
	26	18	19	21	4	5	7	55	6	25	58	23	25	3	35	8	25
	27	16	19	35	4	4	7	56	7	26	55	23	27	3	34	8	26
	28	13	19	48	4	2	7	58	8	27	52	23	28	3	34	8	26
	29	11	20	1	3	0	8	0	9	28	49	23	29	3	34	8	26
	♊	8	20	13	3	59	8	1	10	29	47	23	29	3	34	8	26
21	1	6	20	25	3	57	8	3	11	♋	44	23	29	3	34	8	26
22	2	4	20	37	3	56	8	4	12	1	41	23	28	3	34	8	26
23	3	1	20	48	3	55	8	5	13	2	38	23	27	3	34	8	26
24	3	59	20	59	3	53	8	7	14	3	35	23	26	3	35	8	25
25	4	56	21	10	3	52	8	8	15	4	33	23	25	3	35	8	25
26	5	54	21	20	3	50	8	10	16	5	30	23	22	3	35	8	25
27	6	51	21	30	3	49	8	11	17	6	27	23	19	3	36	8	24
28	7	49	21	39	3	48	8	12	18	7	24	23	17	3	36	8	24
29	8	46	21	48	3	47	8	13	19	8	21	23	13	3	37	8	23
[illegible]	9	44	21	57	3	46	8	14	20	9	18	23	8	3	37	8	23
July [illegible]	10	41	22	5	3	45	8	15	21	10	16	23	5	3	38	8	22
[illegible]	11	38	22	14	3	44	8	16	22	11	13	23	0	3	38	8	22
[illegible]	12	36	22	21	3	43	8	17	23	12	10	22	55	3	39	8	21
[illegible]	13	33	22	28	3	42	8	18	24	13	7	22	50	3	39	8	21
[illegible]	14	30	22	35	3	41	8	19	25	14	4	22	44	3	40	8	20
6	15	28	22	41	3	41	8	19	26	15	2	22	38	3	41	8	19
[illegible]	16	25	22	47	3	40	8	20	27	15	59	22	32	3	41	8	19
[illegible]	17	23	22	54	3	39	8	21	28	16	56	22	24	3	42	8	18
[illegible]	18	20	22	58	3	38	8	22	29	17	53	22	17	3	43	8	17
10	19	17	23	3	3	38	8	22	30	18	50	22	9	3	44	8	16
11	20	14	23	7	3	37	8	23	31								

July 31 days.								Mo. day	*Auguſt* 31 days.							
Sun's place.		Sun's declin.		Sun riſes.		Sun ſets.			Sun's place.		Sun's declin.		Sun riſes.		Sun ſets.	
d.	m.	d.	m.	h.	m.	h.	m.		d.	m.	d.	m.	h.	m.	h.	m.
19♋	48	22N	1	3	45	8	15	1	19♌	27	15N	1	4	34	7	26
20	45	21	53	3	46	8	14	2	20	25	14	43	4	36	7	24
21	42	21	44	3	47	8	13	3	21	22	14	23	4	38	7	22
22	39	21	34	3	48	8	12	4	22	20	14	5	4	40	7	20
23	37	21	25	3	50	8	10	5	23	18	13	46	4	42	7	18
24	34	21	14	3	51	8	9	6	24	15	13	28	4	44	7	16
25	31	21	5	3	52	8	8	7	25	13	13	8	4	46	7	14
26	28	20	53	3	53	8	7	8	26	11	12	49	4	48	7	12
27	26	20	43	3	55	8	5	9	27	9	12	29	4	50	7	10
28	23	20	31	3	57	8	3	10	28	7	12	8	4	52	7	8
29	20	20	20	3	58	8	2	11	29	5	11	48	4	54	7	6
♌	17	20	8	4	00	7	0	12	♍	3	11	28	4	56	7	4
1	15	19	55	4	1	7	59	13	1	0	11	8	4	58	7	2
2	12	19	42	4	3	7	57	14	1	58	10	47	5	0	7	0
3	9	19	28	4	4	7	56	15	2	56	10	27	5	2	6	58
4	7	19	15	4	6	7	54	16	3	54	10	6	5	4	6	56
5	4	19	2	4	8	7	52	17	4	53	9	45	5	6	6	54
6	2	18	48	4	9	7	51	18	5	51	9	23	5	8	6	52
6	59	18	34	4	11	7	49	19	6	49	9	2	5	10	6	50
7	56	18	19	4	12	7	48	20	7	47	8	40	5	12	6	48
8	54	18	4	4	14	7	46	21	8	45	8	18	5	14	6	46
9	51	17	49	4	16	7	44	22	9	43	7	56	5	16	6	44
10	49	17	33	4	18	7	42	23	10	41	7	35	5	18	6	42
11	46	17	18	4	20	7	40	24	11	40	7	12	5	20	6	40
12	44	17	1	4	22	7	38	25	12	38	6	49	5	22	6	38
13	41	16	45	4	24	7	36	26	13	36	6	27	5	24	6	36
14	39	16	28	4	25	7	35	27	14	35	6	4	5	27	6	33
15	36	16	11	4	27	7	33	28	15	34	5	42	5	29	6	31
16	34	15	53	4	29	7	31	29	16	31	5	20	5	31	6	29
17	32	15	36	4	30	7	30	30	17	30	4	57	5	33	6	27
18	29	15	16	4	32	7	28	31	18	28	4	34	5	35	6	25

September 30 days.								Mo. day	*October* 31 days.							
Sun's place.		Sun's declin.		Sun riſes.		Sun ſets.			Sun's place.		Sun's declin.		Sun riſes.		Sun ſets.	
d.	m.	d.	m.	h.	m.	h.	m.		d.	m.	d.	m.	h.	m.	h.	m.
19 ♍	27	4 N	9	5	37	6	23	1	18 ♎	57	7 S	26	6	41	5	19
20	25	3	52	5	39	6	21	2	19	57	7	49	6	43	5	17
21	24	3	34	5	41	6	19	3	20	56	8	11	6	45	5	15
22	22	3	2	5	43	6	17	4	21	56	8	32	6	47	5	13
23	21	2	39	5	46	6	14	5	22	56	8	56	6	49	5	11
24	20	2	15	5	48	6	12	6	23	56	9	18	6	51	5	9
25	18	1	52	5	50	6	10	7	24	55	9	40	6	53	5	7
26	17	1	29	5	52	6	8	8	25	55	10	2	6	55	5	5
27	16	1	6	5	54	6	6	9	26	55	10	24	6	57	5	3
28	15	0	42	5	56	6	4	10	27	55	10	45	7	0	5	0
29	14	0	18	5	58	6	2	11	28	54	11	6	7	2	4	58
♎	12	Sout.	5	6	1	5	59	12	29	54	11	27	7	4	4	56
1	11	0	29	6	3	5	57	13	♏	54	11	49	7	6	4	54
2	10	0	52	6	5	5	55	14	1	54	12	9	7	8	4	52
3	9	1	15	6	7	5	53	15	2	54	12	31	7	11	4	49
4	8	1	39	6	9	5	51	16	3	54	12	51	7	13	4	47
5	7	2	2	6	11	5	49	17	4	54	13	12	7	15	4	45
6	6	2	26	6	13	5	47	18	5	54	13	32	7	17	4	43
7	5	2	49	6	15	5	45	19	6	54	13	52	7	19	4	41
8	4	3	12	6	17	5	43	20	7	54	14	11	7	21	4	39
9	4	3	36	6	20	5	40	21	8	54	14	30	7	23	4	37
10	3	3	59	6	22	5	38	22	9	55	14	50	7	25	4	35
11	2	4	22	6	24	5	36	23	10	55	15	9	7	27	4	33
12	1	4	46	6	26	5	34	24	11	55	15	27	7	29	4	31
13	1	5	9	6	28	5	32	25	12	55	15	45	7	31	4	29
14	0	5	32	6	30	5	30	26	13	56	16	3	7	33	4	27
14	59	5	55	6	32	5	28	27	14	56	16	21	7	35	4	25
15	59	6	18	6	34	5	26	28	15	56	16	39	7	37	4	23
16	58	6	41	6	37	5	23	29	16	57	16	50	7	39	4	21
17	58	7	4	6	39	5	21	30	17	57	17	13	7	41	4	19
								31	18	58	17	34	7	43	4	17

November 30 days.								Mo. day	*December* 31 days.							
Sun's place.		Sun's declin.		Sun rifes.		Sun ſets.			Sun's place.		Sun's declin.		Sun rifes.		Sun ſets.	
d.	m.	d.	m.	h.	m.	h.	m.		d.	m.	d.	m.	h.	m.	h.	m.
19♏	58	17 S	46	7	45	4	15	1	20♐	23	23 S	8	8	23	3	37
20	59	18	2	7	46	4	14	2	21	24	23	12	8	24	3	36
21	59	18	18	7	48	4	12	3	22	25	23	16	8	24	3	36
23	0	18	33	7	50	4	10	4	23	27	23	19	8	24	3	36
24	0	18	48	7	51	4	9	5	24	28	23	22	8	25	3	35
25	1	19	3	7	53	4	7	6	25	29	23	24	8	25	3	35
26	2	19	18	7	55	4	5	7	26	30	23	26	8	25	3	35
27	2	19	32	7	56	4	4	8	27	31	23	27	8	25	3	35
28	3	19	46	7	58	4	2	9	28	32	23	28	8	26	3	34
29	4	19	59	7	59	4	1	10	29	33	23	29	8	26	3	34
♐	5	20	12	8	1	3	59	11	♑	35	23	29	8	26	3	34
1	5	20	25	8	3	3	57	12	1	36	23	29	8	26	3	34
2	6	20	37	8	4	3	56	13	2	37	23	28	8	26	3	34
3	7	20	49	8	6	3	54	14	3	38	23	27	8	25	3	35
4	8	21	1	8	7	3	53	15	4	39	23	26	8	25	3	35
5	9	21	12	8	9	3	51	16	5	40	23	24	8	25	3	35
6	9	21	22	8	10	3	50	17	6	42	23	22	8	24	3	36
7	10	21	33	8	11	3	49	18	7	43	23	19	8	24	3	36
8	11	21	43	8	12	3	48	19	8	44	23	16	8	24	3	36
9	12	21	52	8	13	3	47	20	9	45	23	12	8	23	3	37
10	13	22	1	8	14	3	46	21	10	46	23	7	8	23	3	37
11	14	22	10	8	15	3	45	22	11	48	22	2	8	22	3	38
12	15	20	18	8	16	3	44	23	12	49	22	57	8	21	3	39
13	16	22	26	8	17	3	43	24	13	50	22	52	8	20	3	40
14	17	22	33	8	18	3	42	25	14	51	22	46	8	19	3	41
15	18	22	40	8	19	3	41	26	15	52	22	39	8	18	3	42
16	19	22	47	8	20	3	40	27	16	53	22	32	8	17	3	43
17	20	22	53	8	21	3	39	28	17	55	22	25	8	16	3	44
18	21	22	58	8	22	3	38	29	18	56	22	18	8	15	3	45
19	22	23	3	8	22	3	38	30	19	57	22	9	8	14	3	46
								31	20	58	21	51	8	13	3	47

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